Response to Commentaries on a Model to Predict Work-Related Fatigue Based on Hours of Work

GREGORY D. ROACH, ADAM FLETCHER, AND DREW DAWSON

EACH GROUP AT THE FATIGUE and Performance Modeling Workshop was provided with an array of information to use as model inputs (i.e., time in bed, assumed sleep times, wake time, light exposure, ambient temperature, geographical location, etc.). However, the input file created for FAID had a single input: hours of work (i.e., start/end times of work periods). Furthermore, FAID outputs a single generic variable, i.e., fatigue, rather than a particular measure such as neurobehavioral performance or subjective sleepiness. While it is reasonable to expect that the inclusion of complex inputs and/or secondary transfer functions would lead to superior outputs, the analyses presented by Van Dongen (5) show that none of the models consistently provided better (or worse) predictions of PVT performance or subjective sleepiness than others. This indicates that FAID, with its relatively simple inputs, and arbitrary output variable, had predictive power comparable with the other models.

Interestingly, Van Dongen (5) found that differences between the models were relatively small compared to differences between model predictions and experimental data. Importantly then, the preceding FAID commentaries provide useful guidance for all of the modeling groups to improve the predictive power of their respective models (2,4). For example, Maislin (2) questions the simplifying assumption in all models that the transfer function between inputs and outputs is identical for all individuals. Maislin’s suggestion that an individual’s previous residual errors could be used to calibrate future predictions for that individual within a Bayesian-like framework is of particular interest. Similarly, Rosa’s (4) suggestion that each modeling group consider the applicability of their respective models to industries that involve physically demanding tasks, rather than cognitively demanding tasks, also has merit.

The importance of further modifications to FAID (e.g., using more detailed information about sleep/wake cycles, including an adjustment factor for circadian adaptation to night work) and further validations of FAID (e.g., comparing model predictions with actual job performance and/or safety measures), is highlighted in both commentaries (2,4). We concur, and we have suggested that FAID may be improved with the inclusion of additional modifications to reflect the following possibilities: 1) shifting the timing of sleep/wake, as occurs with night work, may shift circadian phase; 2) specific populations may have relatively advanced/delayed circadian phase; 3) the relative recuperative value of naps and normal sleep periods may differ; 4) the amount of sleep obtained by shiftworkers in time away from work may be industry-dependent; and 5) the recovery value of non-work periods during layovers for international aircrew may be considerably disturbed by rapid time zone transitions (3).

In both commentaries (2,4), further clarification of which aspects of FAID are proprietary is requested. Briefly then, the circadian components of fatigue/recovery are represented in FAID by approximately sinusoidal functions, with periods of 24 h, maximum fatigue/recovery values at 05:00, and minimum fatigue/recovery values at 17:00. The values contained in the fatigue/recovery functions are proprietary, but the algorithms contained in FAID that describe how these functions are used to calculate the level of fatigue associated with any duty schedule are in the public domain (1).

REFERENCES

2. Maislin G. Commentary on a model to predict work-related fatigue based on hours of work. Aviat Space Environ Med 2004; 75(3,suppl.):A70–7.
4. Rosa RR. Commentary on a model to predict work-related fatigue based on hours of work. Aviat Space Environ Med 2004; 75(3,suppl.):A72–3.

From the Centre for Sleep Research, University of South Australia, The Queen Elizabeth Hospital, Woodville, SA, Australia.

Address reprint requests to: Drew Dawson, Ph.D., Centre for Sleep Research, University of South Australia, Level 5, Basil Hetzel Institute, The Queen Elizabeth Hospital, Woodville SA 5011, Australia; drew.dawson@unisa.edu.au.

Gregory D. Roach, Ph.D., is currently a Post-doctoral Research Fellow, Centre for Sleep Research, University of South Australia.

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